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A NEW ANCHITHERIINE HORSE FROM THE TUNG GUR FORMATION OF MONGOLIA[1]

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INTRODUCTION

The purpose of this paper is to describe a new anchitheriine horse, found in the Tung Gur beds of Mongolia by the Central Asiatic Expedition of 1930, to compare it with related forms in Eurasia and North America, and finally to discuss the significance of this fossil in the Tung Gur formation. This last point is of considerable importance, not only because of its bearing on the distribution of the anchitheriine horses throughout the northern hemisphere, but also because of its significance as to the correlative relationships of the Tung Gur horizon.

The illustrations for this paper were made by Mr. John C. Germann.

DESCRIPTION AND DISCUSSION

Anchitherium gobiense, new species

TYPE.—Amer. Mus. No. 26502, a right maxilla containing P^1–M^3.

PARATYPES.—Amer. Mus. No. 26503, mandible with right and left I_{1-3}, right P_{1-3}, M_{2-3}, left P_1–M_3. Also a right tibia, a right metacarpal III and a right metacarpal IV. These bones were found in the same quarry with the mandible, and it is probable that they came from one individual. Amer. Mus. Nos. 26604, fragment of a left mandibular ramus with P_{2-3}; 26554, four lower cheek teeth, right P_3–M_2; 26555, a right astragalus; 26556, a left astragalus; 26557, a left astragalus; 26558, a median phalanx.

HORIZON.—Tung Gur formation, Upper Miocene.

LOCALITY.—For the type—Tung Gur escarpment, twenty-five miles northeast of Gur Tung Khara Usu. For the paratypes—(26503) quarry at Wolf Camp; (26554, 26555, 26556, 26557, 26558) Tung Gur escarpment, near the Wolf Camp quarry; (26604) exact locality not recorded.

DIAGNOSIS.—An *Anchitherium* somewhat larger than *A. aurelianense* but generally comparable to this species as regards form. Upper cheek teeth brachyodont, transversely broad, with well-developed internal cingula but without external vertical ribs on ectoloph of paracone and metacone. Hypostyle of upper molars more expanded than in *A. aurelianense*. Last upper molar generally more reduced than in *Anchitherium aurelianense*, but less so than in the North American form, *Anchitherium* (= *Kalobatippus*) *agatense*. Lower incisor series narrowly rounded, even narrower than the incisor series in *Anchitherium aurelianense:* P_1 present but very small. Lower cheek teeth rather tall, with the metastylid tending to be distinct in the unworn tooth, and with strong anterior, external and posterior cingula. Lower molars progressively reduced from front to back, and M_3 relatively small. Lateral metapodials heavy; astragalus with small cuboid facet.

So far as it is possible to judge from the dentition and the feet, this new horse from the Gobi is very close to the well-known European species, *Anchitherium aurelianense*. Consequently it is to be regarded as a true *Anchitherium*, and not a *Hypohippus*—in those characters whereby this latter genus is distinct from *Anchitherium*.

The Gobi form resembles *Anchitherium aurelianense* in the general proportions of the upper and lower cheek teeth, in the similar size of P^2, in the almost identical degree of cross-cresting of the grinders and in the development of internal cingula and the lack of external cingula on these teeth, in the relative degree of reduction of the last upper molar and similarly in the reduction of the last lower molar, in the tendency for the metastylid to be separate in the lower cheek teeth, and finally in the general proportions of the foot and the strength of the lateral metapodials.

[1] Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 138.

Naturally, on the basis of this impressive array of resemblances the question arises as to whether the Mongolian fossils are specifically identical with the European species. In answer to this, it may be said that there are numerous differences between this new form from the Gobi and the European species, and these differences (to be discussed below) together with the great geographic separation of the forms, are considered as sufficiently important to justify the establishment of a new specific designation for the material now under consideration.

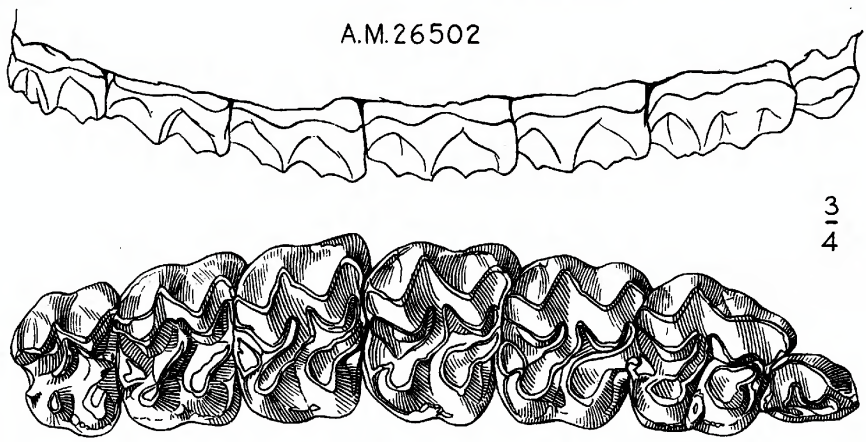

Fig. 1.—*Anchitherium gobiense*, new species. Type, Amer. Mus. No. 26502, right P^1–M^3. Lateral view above, crown view below; three-fourths natural size.

These are the notable differences between *Anchitherium gobiense* and *Anchitherium aurelianense*.

1.—The Mongolian species is appreciably larger than the European form. Although some examples of *Anchitherium aurelianense* are close to *Anchitherium gobiense* in size, the general average for the European species would seem to be considerably smaller than that for the Mongolian form. Moreover, the teeth of *Anchitherium gobiense* give the impression of being much heavier and more robust than those of *Anchitherium aurelianense*.

2.—In the upper cheek teeth the hypostyle is heavier and more expanded in the Mongolian species than it is in *Anchitherium aurelianense*. This distinction, caused by the differential growth of a single element relative to the tooth as a whole in the two species, would seem to denote a slightly more advanced condition in the Mongolian form.

3.—There are no vertical "ribs" on the ectoloph surfaces of the upper cheek teeth in *Anchitherium gobiense*, whereas these structures are often present in the teeth of *Anchitherium aurelianense*. Since this character is exceedingly variable in the latter species, it cannot be regarded as of very great importance.

4.—For the most part, the last upper molar is relatively somewhat more reduced in *Anchitherium gobiense* than it is in the European species. In the type of *Anchitherium gobiense* the reduction of the M^3 has gone so far that the posterior moiety of the tooth is considerably smaller than the anterior portion.

5.—The lower incisor series would seem to be compressed transversely to a somewhat greater degree than is the case in *Anchitherium aurelianense*.

6.—The lower incisors of the Mongolian species are very heavy and large. They are characterized by very heavy ridges on their lingual surfaces.

There are lower cheek teeth of three individual animals in these remains from the Tung Gur beds, namely, the complete lower jaw, No. 26503, the fragment from the anterior portion of a left ramus, No. 26604, and the four separate teeth, No. 26554. Of these specimens the four separate teeth are particularly interesting in that they show the condition prevailing in the unworn lower grinders of this species. These teeth are rather tall, and they show a slight but distinct separation of the metaconid and the metastylid. They are characterized by the strong basal cingulum running from the antero-internal corner of the tooth around the outside, to the postero-internal corner. The postero-internal termination of this cingulum is elevated and somewhat swollen.

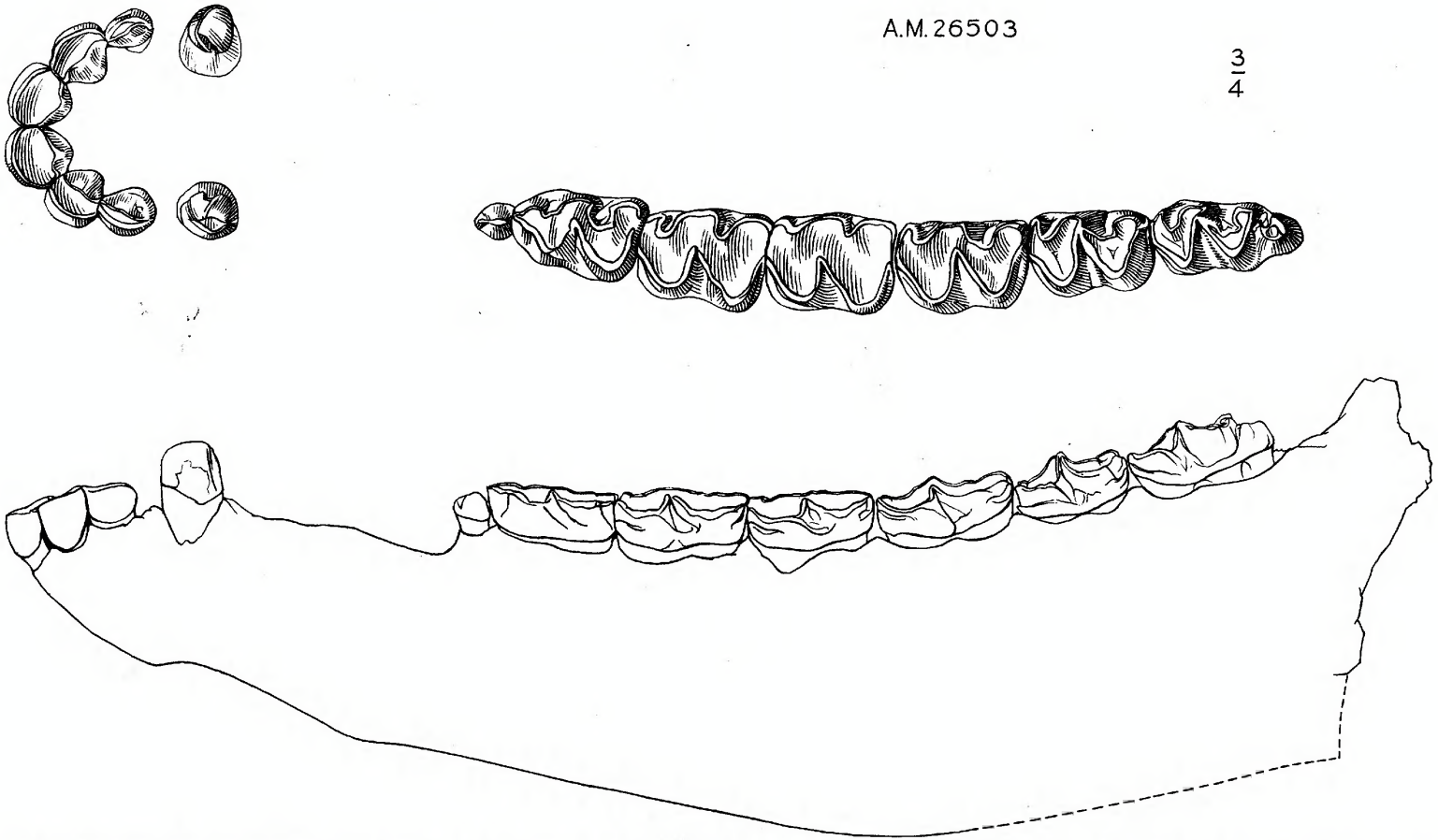

Fig. 2.—*Anchitherium gobiense*, new species. Paratype, Amer. Mus. No. 26503, mandible. Crown view of incisors, canines and left cheek teeth above, lateral view of left mandibular ramus below. Three-fourths natural size.

All of these characters are typical of *Anchitherium*.

The teeth from these three individuals also show a certain amount of variation as to size. The fragmentary ramus is the smallest specimen, and it is noticeably smaller than the complete jaw, which is of a size corresponding very well to the type

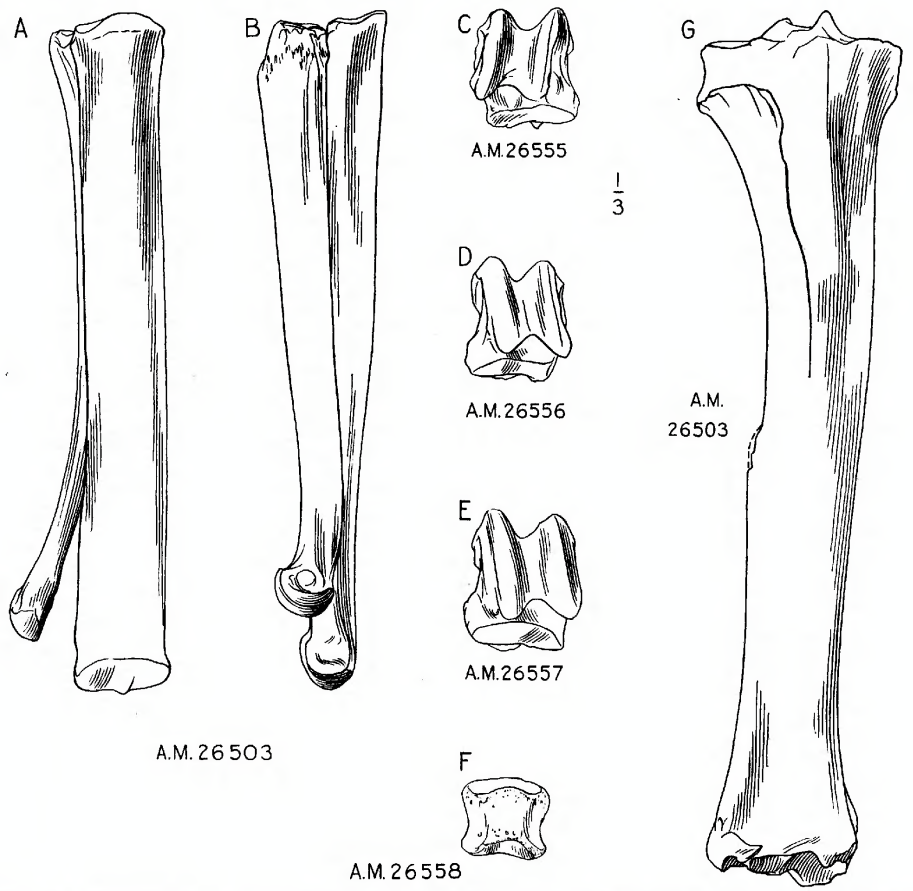

Fig. 3.—*Anchitherium gobiense*, new species. Paratypes: Amer. Mus. Nos. 26503, right metacarpals III and IV, and right tibia; 26555, right astragalus; 26556, left astragalus; 26557, left astragalus; 26558, median phalanx. Metacarpals III and IV, (A) front view, (B) lateral view of right side. Tibia (G), astragali (C, D and E) and phalanx (F), front views. All one-third natural size.

upper teeth. Finally, the separate teeth are the largest, being somewhat larger than the teeth of the complete mandible.

The third metacarpal is somewhat more than one and one-half times as long as the lower premolar-molar series, and somewhat less than twice the length of these lower teeth. The proximal articular surface of this bone is occupied almost exclusively by the facet for the magnum, with seemingly a very small facet for the unciform. The fourth metacarpal is very strong, and but slightly shorter than the middle toe bone. Its proximal end is occupied by a small, vertical articular surface for the third metacarpal and a large, single horizontal facet for the unciform.

There is a single median phalanx of the third digit, which because of its great breadth, as compared with its length, is here considered as belonging to a fore-foot.

The tibia-fibula is about twice as long as the lower premolar-molar series. The tibia is of the usual equine form, with a strong tibial crest and with a very prominent ridge on the back of the bone, probably for the

origin of the flexor longus digitorum muscles. The distal end of the fibula, forming the external malleolus, is distinctly separated from the tibia in the astragalar trochlea by a suture line. Moreover, the lower half of the fibula, though so greatly reduced and so firmly fused to the tibia as to be a functional part of this latter bone, can be traced along the external side of the tibia, from a point about midway on the shaft to the external malleolus. Evidently the fibula was free from about the middle of the tibial shaft to its head. As might be expected, the two astragalar trochleae form a sharp angle with the antero-posterior median plane of the tibia.

There are three astragali representative of three individuals in the equid remains from the Tung Gur locality. There is no reason to think that these astragali are other than of *Anchitherium*, yet they show variations, each from the other, that denote a considerable degree of latitude in the development of these bones in a single species. Two of these bones, Nos. 26556 and 26557, are similar to each other in their general proportions, although the latter is considerably larger than the former. The third astragalus, No. 26555, is somewhat broader in comparison to its height than are the other two bones, so that it has a "squattier" appearance than the first-two named specimens. This latter astragalus is interesting, too, in that it shows a fusion of the ectal and sustentacular facets for the calcaneum, to form a long, single articulating surface, whereas in the other two astragali the sustentacular and ectal facets are distinct from each other.

Two anchitheriine horses have been previously described from Asia, namely, *Hypohippus zitteli* (originally placed in the genus *Anchitherium*) and *Anchitherium hypohippoides*, the former from China, the latter from Japan. It may be well at this point to compare the new Mongolian species with these forms that are geographically close to it.

Whether *Hypohippus zitteli* is a true *Hypohippus* or an *Anchitherium* is a question beyond the range of the present discussion. Suffice it to say at this point that although *Hypohippus* is generally a more advanced anchitheriine of a later geologic age than is *Anchitherium* itself, the establishment of a distinct line of demarcation between the two genera is exceedingly difficult. They merge through a series of intergrading species.

Hypohippus (or *Anchitherium*) *zitteli* is a more advanced form than *Anchitherium gobiensis*, larger, with the cheek teeth more elongated (thereby making them square, rather than transversely broad) and with the cross crests more oblique and more completely connected with the ectoloph. There is every reason to think on the basis of structure alone, that *Hypohippus zitteli* is a later form than *Anchitherium gobiense*, as indeed it is, since it occurs with *Hipparion* in beds that are definitely of Pontian affinities.

Anchitherium hypohippoides was described by Matsumoto on the basis of some extremely fragmentary and isolated teeth. Therefore the species is at best indefinite. It would seem that this form, particularly as judged by a lower grinder figured by Matsumoto, is very close to *Anchitherium gobiense*. The Japanese fossil is, however, so incomplete that no significant comparisons in this direction are possible.

Recently, 1937, Borissiak has described a new anchitheriine horse from the Middle Miocene[1] of the Caucasus region. This equid he has placed in a new genus and species, *Paranchitherium karpinskii*, on the basis of its supposed differences from any of the anchitheriines hitherto described.

This new form differs from *Anchitherium* (as exemplified by *Anchitherium gobiensis*) by the somewhat differently proportioned upper cheek teeth—they are not quite so elongated as in *Anchitherium*—by the more slender P^1, by the lesser amount of reduction of the posterior molars, particularly the last upper molar, and by the presence of a distinct crochet on the metaloph. In all of these characters the new Russian form resembles to a considerable degree the American genus, *Parahippus*, a fact that is stressed by Borissiak.

On the other hand, there are certain *An-*

[1] Not Pliocene, as stated in the English translation summarizing the paper, which is in Russian.

chitherium resemblances to be seen in this new form, especially the unexpanded protoconule, the separation of the upper canine from the last incisor and the large size.

Borissiak mentions that the symphysis of this form is similar to the symphysis in *Parahippus*, as are the lateral metapodials, which are more reduced than the same elements in *Anchitherium*. His description of the fusion of the distal portion of the fibula with the tibia would seem to constitute a resemblance between this new species and the Tung Gur *Anchitherium*.

All in all, the differences between *Paranchitherium* and *Anchitherium gobiensis* are sufficiently marked to justify the separation of the two forms as distinct types. Whether the new Caucasian anchitheriine should be placed in a genus separate from *Anchitherium* is a question that might be open to some debate—yet there can be no doubt but that specifically a real difference between the Mongolian and the Russian forms does exist.

Summing up the foregoing description and comparisons it may be said that *Anchitherium gobiense* is a true *Anchitherium*, and it is more closely comparable to *Anchitherium aurelianense* than it is to any other species of the anchitheriine horses. Certain differences serve to distinguish this Mongolian equid from the characteristic European form, but the differences between the two species are for the most part of minor importance. The numerous resemblances between them show that they are very closely related—a relationship that implies a near, if not an exact equivalence in the geologic age of these two species.

THE BEARING OF *ANCHITHERIUM GOBIENSE* ON THE CORRELATION OF THE TUNG GUR FORMATION

The presence of *Anchitherium gobiense* in the Tung Gur formation affords the strongest and most conclusive evidence yet adduced in favor of an Upper Miocene age for these beds. As the present author has shown elsewhere, various elements in the Tung Gur fauna are indicative of the Miocene age of this assemblage. Particularly significant are *Amblycastor*, *Hemicyon*, *Aceratherium*, *Listriodon*, *Stephanocemas*, *Palaeotragus* and *Oioceras*, all of which forms in the Tung Gur beds show affinities to Upper Miocene species of the same or related genera in other parts of the world. Yet the evidence of these genera, though strong to say the least, has not been conclusive, since all of them might very well have persisted into the Lower Pliocene.

It is the presence of a true *Anchitherium* together with these other characteristic Upper Miocene types that clearly establishes the age of the Tung Gur beds. *Anchitherium gobiense* is so very close to the Upper Miocene *Anchitherium aurelianense* of Europe that their contemporaneity would seem to stand without question. Moreover, *Anchitherium gobiense* is definitely less advanced than the Pontian anchitheriine of China, *Hypohippus zitteli*.

In this connection it is to be noted that von Koenigswald has shown the persistence of *Anchitherium* into the Pontian of Europe; but in this case *Anchitherium* is associated with *Hipparion*, just as *Hypohippus zitteli* is associated with *Hipparion* in the Pontian of China. Moreover, the Pontian *Anchitherium* described by von Koenigswald, though placed by this author in the species, *A. aurelianense*, is nevertheless a very large, advanced form, more or less comparable in this respect to *Hypohippus zitteli* of China. In fact, it was the large size of the European Pontian *Anchitherium* that convinced von Koenigswald, among other things, of its post-Miocene affinities.

"Die ausserordentliche Grösse unseres *Anchitherium* spricht dafür, dass diese Art im Dinotheriumsande tatsächlich ein postmiocänes, pontisches Alter besitzt."[1]

Consequently, the closest comparisons to *Anchitherium gobiense* are still to be found in the typical Upper Miocene *Anchitherium aurelianense* of Europe, and not in the Pontian form as described by von Koenigswald.

Finally, as an important factor bearing on this question, there is the complete absence of *Hipparion* in the Tung Gur faunal assemblage. While conclusions based on the absence of certain diagnostic forms are apt to be dangerous, it would seem that in

[1] von Koenigswald, G. H. R. 1931. Centralbl. für Min., etc., Jahrg. 1931, Abt. B, No. 1, p. 43.

the present instance the lack of any traces of *Hipparion* in the Tung Gur beds is truly indicative of the fact that this Pliocene horse had not yet arrived in Asia. Nor can the absence of *Hipparion* be attributed entirely to a facies phase of the Tung Gur fauna, for if the Tung Gur were strictly a forest assemblage, as might be indicated by the presence of *Anchitherium* and the absence of *Hipparion*, one would not expect to find many forms adapted to a mixed forest and plains, or an open plains environment, such as make up the bulk of the fauna. It would seem probable that the Tung Gur fauna is actually a borderland assemblage, containing forest forms and plains forms intermingled. Evidently these mammals were living on a broad flood-plain, traversed by numerous tree-bordered rivers.

The age relationships of the Upper Tertiary horses of Mongolia and China might be represented in the following manner.

Lower Pliocene Pontian	*Hypohippus zitteli*	*Hipparion*
Upper Miocene Tung Gur	*Anchitherium gobiense*	No *Hipparion*

A comprehensive study of the genus *Anchitherium* was recieved after this paper had been set in galley proof. It has a bearing on the problem in hand, but unfortunately cannot be included here. See Wehrli, H., 1938. "Anchitherium aurelianense Cuv. von Steinheim A. Albuch und seine Stellung im Rahmen der Ubrigen Anchitherium Pferde," Teil VII of "Die Tertiären Wirbeltiere des Steinheimer Beckens" Palaeontographica, Suppl.-Band VIII.

Measurements

		Anchitherium gobiense A.M. 26502	*Anchitherium aurelianense*[1] (from Kowalevsky)	*Anchitherium* (= *Kalobatippus*) *agatense* (from Romer)
P^1–M^3	length	136.5 mm.	126.5 mm.	135 mm.
P^2–M^3	"	121	114	120
P^1–P^4	"	79	72	
M^1–M^3	"	60	55	*Kalobatippus praestans*[2]
P^1	length × width	16.5 × 11		14 × 9
P^2	" "	21 × 25.5	19.5 × 22.5	17.5 × 21
P^3	" "	21 × 27	19 × 23	16.5 × 22.5
P^4	" "	22 × 28.5	20 × 24	16 × 23.5
M^1	" "	21 × 28	20 × 24	16.5 × 21.5
M^2	" "	20 × 28	18 × 24	16 × 22.5
M^3	" "	17 × 24.5	16.5 × 22	15.5 × 21.5

		Hypohippus zitteli[3] (from Schlosser)
P^2	length × width	27 × 24.5
P^3	" "	29 × 35
P^4	" "	26.5 × 33.5
M^1	" "	23.5 × 26.8
M^3	" "	21 × 25

[1] Measured from figure.
[2] Measured from type.
[3] P^3, P^4 measured from figure.

		Anchitherium gobiense A.M. 26503	A.M. 26604	A.M. 26554	*Anchitherium aurelianense*[1] (from Kowalevsky)	*Anchitherium* (= *Kalobatippus agatense*) (from Romer)
P_1–M_3	length	139 mm.			132 mm.	137 mm.
P_2–M_3	"	132.5			125	127
P_1–M_4	"	72			69	
						Kalobatippus praestans[2]
M_1–M_3	"	67.5			64	
P_1	length × width	6.5 × 6.5				8.5 × 5
P_2	" "	22 × 15	19.5 × 11		21 × 13	18 × 11.5
P_3	" "	21.5 × 17.5	20 × 13	24.5 × 18	19 × 14	17 × 13.5
P_4	" "	22 × 17.5		24.5 × 18.5	20 × 16	17 × 14
M_1	" "	22 × 16		25 × 17	20 × 15	17 × 13
M_2	" "	20 × 14.5		23 × 16	20 × 14	19.5 × 12.5
M_3	" "	24.5 × 12			22 × 13	22 × 11
I_1–M_3	length	220			201	179
I_3–P_1	diastema	54			46	47
I_1	length × width	11.5 × 10.5				
I_2	" "	10.5 × 10				
					Hypohippus zittelli[3] (from Schlosser)	
I_3	" "	8 × 8.5				
C	" "	10 × 8.5			P_2	26 × 16
Depth of ramus at M_1		52			P_3	30 × 20
					M_1	26
					M_2	26

[1] Measured from figure.
[2] Measured from type.
[3] P_2–P_3 measured from figure.

	Anchitherium gobiense A.M. 26503
Mc. III, length	245 mm.
width, mid-shaft	30
Mc. IV, length	220
anteropost. diam., mid-shaft	18
Median phalanx, length (A.M. 26558)	25
width (A.M. 26558)	31.5

	Anchitherium gobiense A.M. 26503
Tibia, greatest length	316
proximal width	73
width, mid-shaft	36

	A.M. 26555	A.M. 26556	A.M. 26557
Astragalus			
height	41	42	47.5
breadth	40	38	43

Ratios and Indices	*Anchitherium gobiense*	*Anchitherium aurelianense*[1]	*Hypohippus*[1]	*Kalobatippus agatense*
P^2–M^3 × 100 / Mc. III	50	62	66–69	54
P_2–M_3 × 100 / Mc. III	54	65	73–74	58
P_2–M_3 × 100 / Tibia	42			

[1] From Romer.

Indices	*Anchitherium gobiense*	*Anchitherium aurelianense*	*Hypohippus zitteli*	*Hypohippus equinus*	*Hypohippus osborni*	*Kalobatippus praestans*
P^2	83	87	125	78	105	83
P^3	78	83	95	74	90	73
P^4	74	83		73	90	68
M^1	74	83	89	77	88	75
M^2	71	75		78	74	71
M^3	68	75	84	78	75	72

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